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Pyrolysis Process for Conversion of Biomass into Energy Products

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Biofuel Production Via Fast Pyrolysis




Biomass

Fast Pyrolysis

Heat in absence of oxygen. High heating rates and lower temperatures maximizes oil production.

Pyrolysis Products

Bio-Oil
+

Bio-Char
+
Pyrolysis Gas

Can recycle gas as energy input to pyrolysis unit

Direct Usage

Fuel Oil Replacement → **Electricity, Steam/ Heat Production**

Upgrading Processes →

Formulation of Transportation Fuels
Green Diesel, Gasoline & Jet Fuel

Soil amendment, CO_2 sequestration

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Amaron Energy's Advanced Portable Pyrolysis Unit*

- Prototype operating unit ½ ton/ day capacity
- 3 years of operation and data collection
- 14 feed stocks tested
- Robust feedstock acceptance
- In design phase for 10 ton/day demonstration scale unit

* US Patent 8,298,498 B2
Method and apparatus for achieving fast pyrolysis in indirectly heated rotary reactors

* US Patent Application US2012/0063965 A1
Method and apparatus for fast pyrolysis of biomass in a rotary kiln

0.5 ton/day prototype pyrolysis unit

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Products Produced through Pyrolysis

- Bio Oil
  - Could be used as petroleum boiler fuel replacement
  - Potential for drop in fuel feedstock after upgrading
- Bio Char
  - Reclamation
  - Filtration Media
  - Bio Coal
- Electrical Power
  - Use of pyrolysis gas in generator

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Product Yields Obtained with 0.5 ton/hr Amaron Energy Prototype Unit

Material	Test hrs	Typical yields %			Typical C1 oil HHV	
		Oil	Char	Gas	BTU/lb	
Pinion-Juniper wood	176	59	30	11	10,291	torrefied
Black Liquor	169	37	38	25		
Fir pellets	132	62	23	16	7,620	
Fir fines	112	59	19	22		
Lemna	47	44	28	28	11,383	
Pine shredded	16	58	30	12	6,851	
Pine bark	3	34	36	30		
MSW sorted	12	54	15	31	17,019	
Brown Grease	12	53	2	45	18,188	
Tire rubber	10	31	42	27	17,135	
Phragmites	10	28	36	36		
Turkey litter	6	46	35	19	3,695	
Aspen	4	43	28	29		
USU Algae	2	25	51	24		
Total test hours	710					

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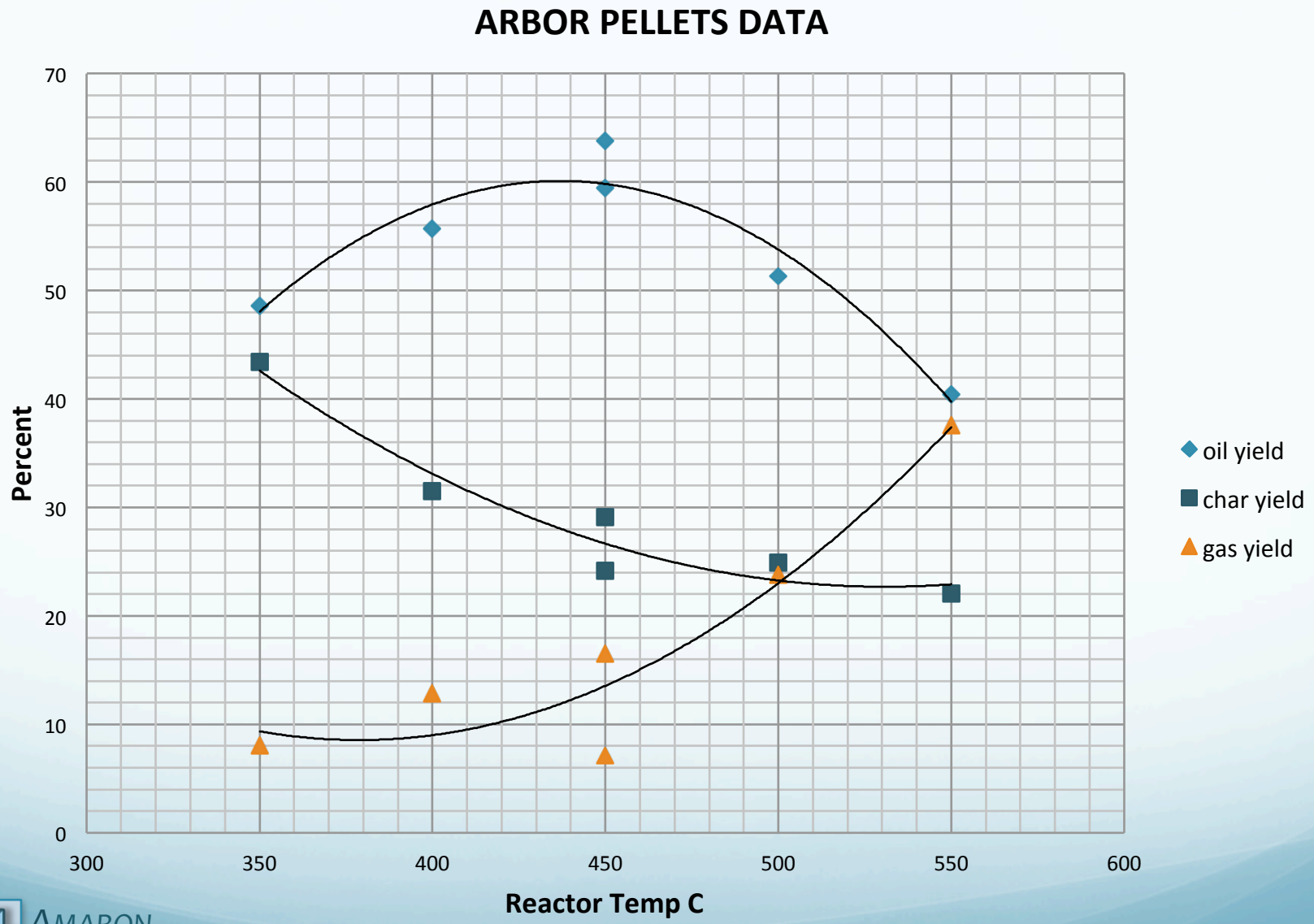
VARIATION OF YIELDS Δ T



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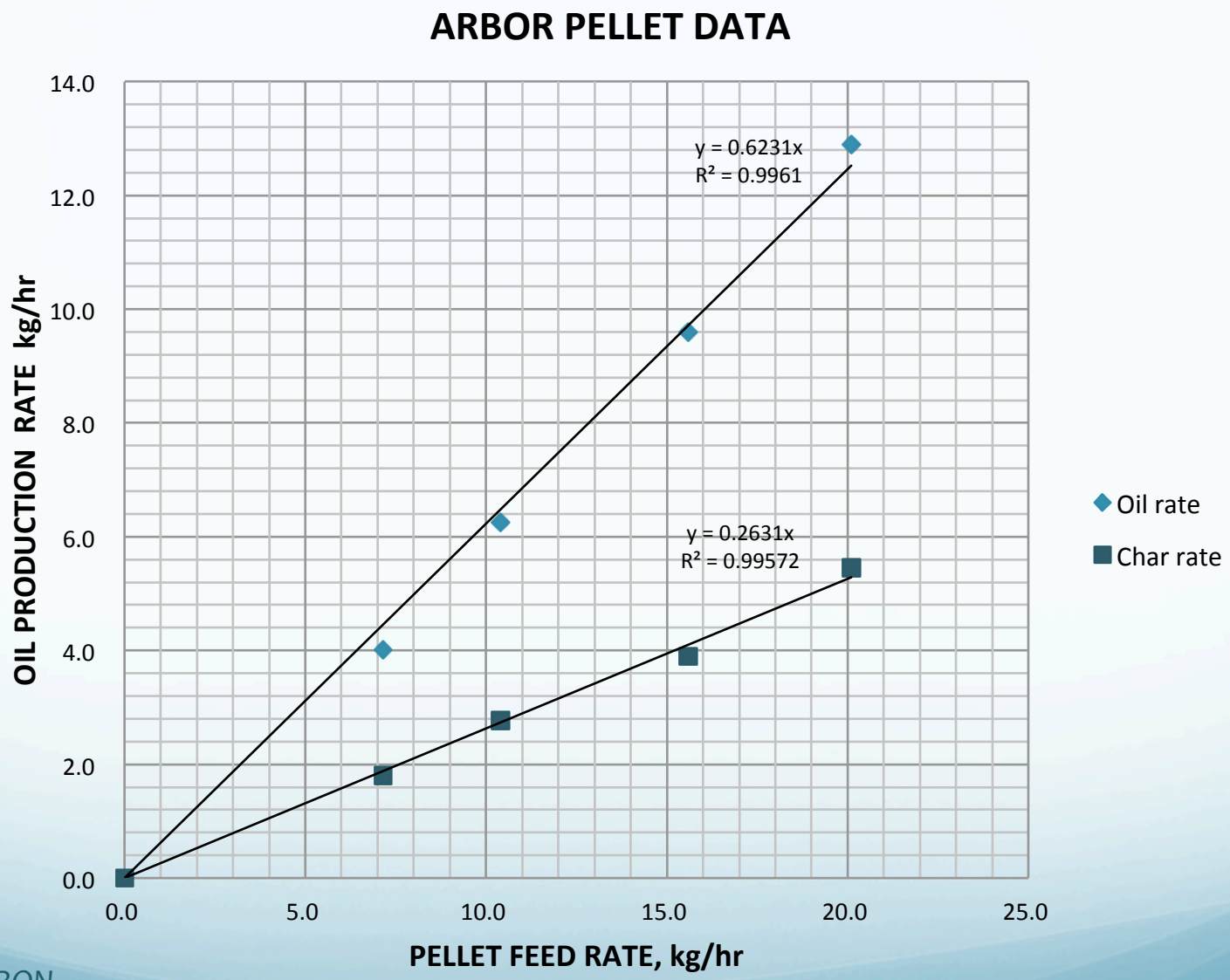

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Business Case & Competitive Advantages

- Mobile pyrolysis unit available to serve non-traditional markets
  - **Bio-Oils** – renewable source of energy from waste feedstock
  - **Bio-Char** – remediation, polluted locations to amend soil
  - **Activated Carbon** – could play in Mobile& local market
  - **Remote Location** and Secure Location Access (Next Slide)
- Advantages of rotary reactor
  - **Fluidizied bed equipment not required (lower CapEx)**
  - **Bio-Char cooling heat recovery**
  - **High quality Bio-Char**

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Research and Development Associates and Customers

- Washakie Renewable Energy
- Tooele Army Depot
- University of Utah
- Utah State University
- Utah Biomass Resources Group
- Washington State University

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Milestones & Ask

- Manufacture 20 inch – (10 ton/ day) mobile unit
  - Using a 40 foot shipping container
  - Est. Completion - mid 2013

$400,000 and about 6 months

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Questions ?

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